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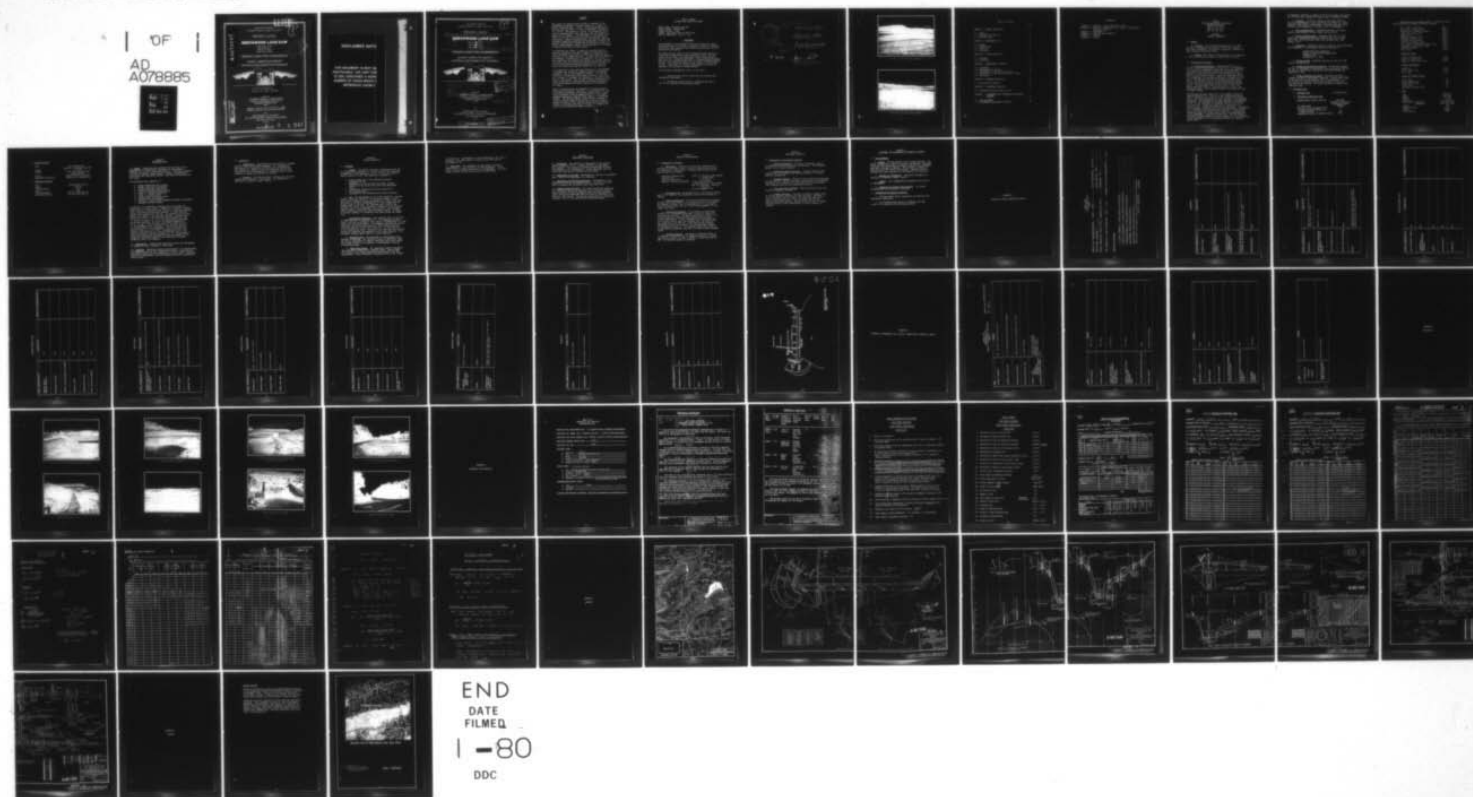
KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA
NATIONAL DAM INSPECTION PROGRAM. BEECHWOOD LAKE DAM (NDS ID
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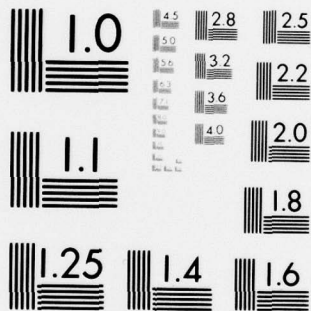
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SUSQUEHANNA RIVER BASIN
EAST BEECH WOODS of MILL CREEK, TIOGA COUNTY

PENNSYLVANIA

BEECHWOOD LAKE DAM

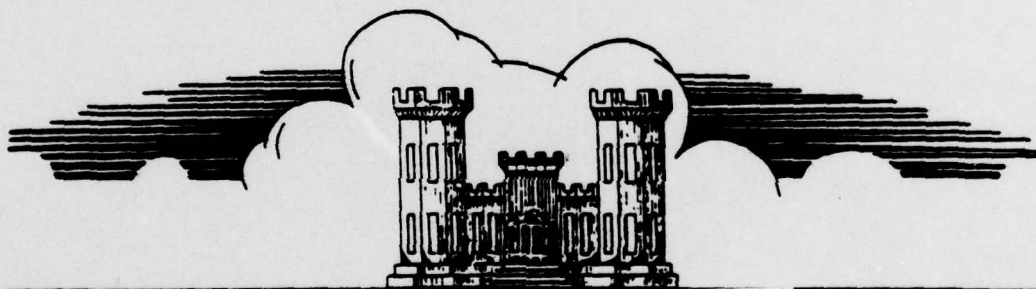
NDS ID NO. PA-37

DER ID NO. 59-61

SCS ID NO. PA-454

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Contract No. DACW31-79-C-0009

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

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DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

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SEPTEMBER, 1979

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SUSQUEHANNA RIVER BASIN
EAST BEECH WOODS of MILL CREEK, TIOGA COUNTY

PENNSYLVANIA

6 National Dam Inspection Program.

BEECHWOOD LAKE DAM

(NDS ID NO. PA-37, Number

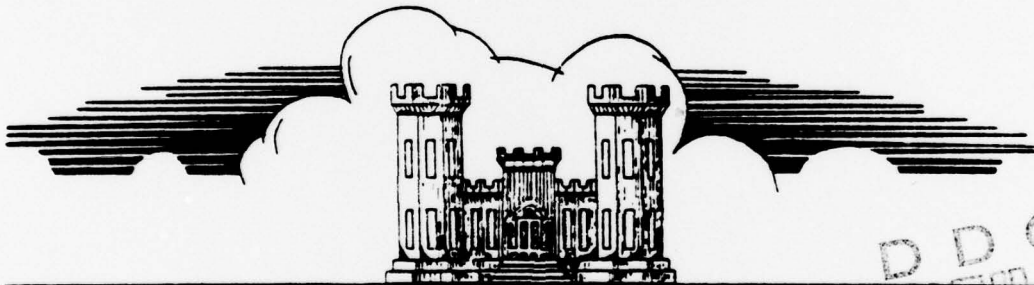
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East Beech Woods of Mill Creek, Tioga County, Pennsylvania

PENNSYLVANIA FISH COMMISSION

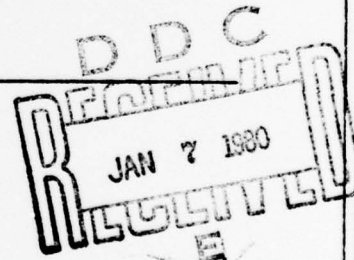
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



15 DADW31-79-C-0009

10 Kuang-hwei / Chung
R. Jeffrey / Kimball Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931



42 71

FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

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SEPTEMBER, 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM: Beechwood Lake Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Tioga
STREAM: East Beech Woods of Mill Creek
DATE OF INSPECTION: June 27, 1979

*Cont'd from
page 12*

ASSESSMENT

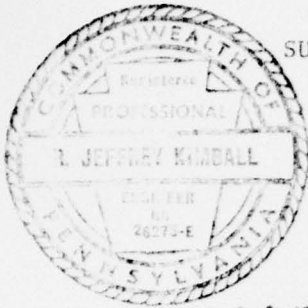
The assessment of the Beechwood Lake Dam is based upon visual observations made at the time of inspection, review of available records and data, hydrology and hydraulic computations, and past operational performance.

The inspection and review of data of Beechwood Lake Dam did not reveal any problems which require emergency action. The dam appears to be stable, well maintained, safely operated and in good condition. Beechwood Lake Dam is a high hazard-intermediate size dam. The spillway design flood is the PMF (Probable Maximum Flood). The spillway and reservoir are capable of controlling the PMF. Based upon the criteria established by the Corps of Engineers, the spillway is termed adequate.

The following recommendation should be instituted:

1. Continue annual safety inspections and operation and maintenance inspections.
2. The warning system should be formalized and made a part of the operation and maintenance manual.

BEECHWOOD LAKE DAM (PA-37)



SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

Kuang-hwei Chuang
Kuang-hwei Chuang, P.E.

SEP 14 1979

Date

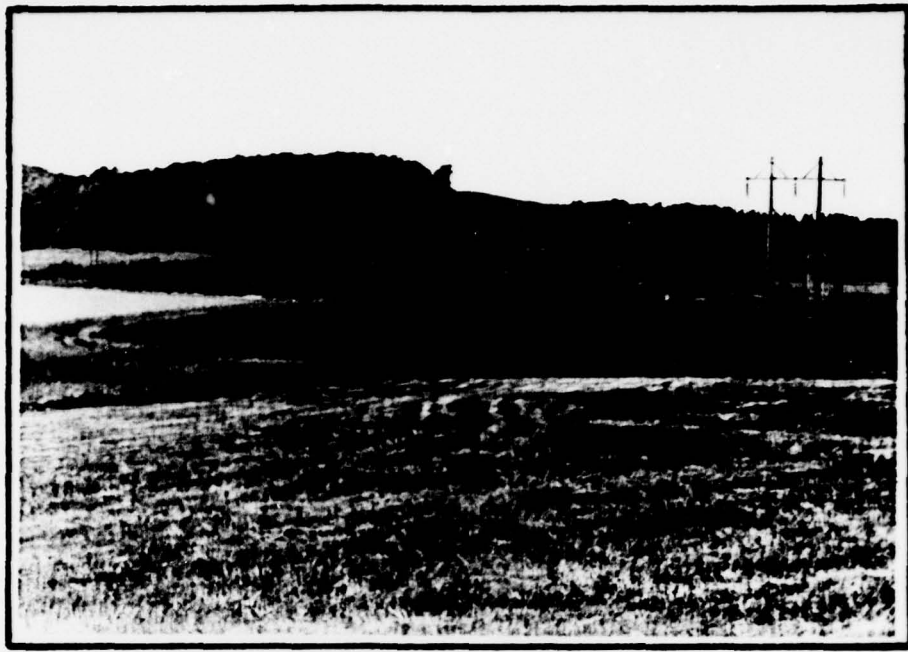
R. Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

25 Sep 79

Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of dam from right abutment.



Overview of dam from left abutment.

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PHASE I
NATIONAL DAM INSPECTION PROGRAM
BEECHWOOD LAKE DAM
NDI I.D. NO. PA 37
DER I.D. NO. 59-61
SCS I.D. NO. 454

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Beechwood Lake Dam is an earthfill dam 1030 feet long and 63 feet high. The embankment is a zoned earth embankment consisting of a center impervious core section with pervious upstream and downstream zones. Beneath the impervious section is a 10 foot wide core trench which acts as a partial cutoff. Under the downstream portion of the embankment is a seepage drain which is parallel to the axis of the dam and ties into the principal spillway impact basin. The upstream slope is 3H:1V and covered with riprap in the vicinity of the orifice invert and principal spillway invert. The downstream slope is 2H:1V with a 7 foot wide berm at elevation 1769.0. The crest width is 20 feet. The downstream slope, crest and upper portion of the upstream slope are grass covered.

The principal spillway consists of a 30" diameter reinforced concrete pipe with a 2.5 foot x 7.5 foot reinforced concrete riser. The riser unit is 50 foot high, located in the upstream zone of the fill approximately 52 feet upstream of the embankment centerline. Flow through the principal spillway is controlled by two 7.5 foot long weirs at elevation 1791.0 at the top of the riser unit. Normal pool elevation is controlled by an orifice invert at elevation 1787.0 on the riser unit. In addition, a 24" reinforced concrete drainpipe is placed from the upstream toe of the dam to the bottom of the riser unit. A slide gate operated by means of a slide stem is laid on the upstream slope of the embankment to operate the drain line. The 30" diameter principal spillway conduit has cutoff collars at 22 foot intervals. At the discharge end of the principal spillway is a concrete impact basin.

[continued on
p. 11]

The emergency spillway is located on the left abutment and consists of a 150 foot wide, trapezoidal shaped open cut grassed spillway.

b. Location. The dam is located on East Beech Woods of Mill Creek approximately 1 mile southeast of Sabinsville, Clymer Township, Tioga County, Pennsylvania. Beechwood Lake Dam can be located on the Sabinsville 7.5 minute U.S.G.S. quadrangle.

c. Size Classification. Beechwood Lake Dam is an intermediate size structure (63 feet high, 2400 acre-feet).

d. Hazard Classification. Beechwood Lake Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail (See Section 3.1e).

e. Ownership. Beechwood Lake Dam is owned by the Pennsylvania Fish Commission. Correspondence should be addressed to:

Pennsylvania Fish Commission
Bureau of Fisheries and Engineering
Robinson Lane
Bellefonte, PA 16823

f. Purpose of Dam. Beechwood Lake Dam is used for flood control and recreation.

g. Design and Construction History. The dam was designed by the U.S. Department of Agriculture, Soil Conservation Service. The dam was constructed by McCormick Contracting Company and completed in 1963.

h. Normal Operating Procedures. Beechwood Lake Dam is designed to control flow without operation. During normal flows, a pool elevation of approximately 1787.0 is maintained. It is not possible to manually control flow through the principal spillway during flooding. The drain line valve is opened three times each year.

1.3 Pertinent Data.

a. Drainage Area. 3.3 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	June 1972
	Maximum elevation and discharge unknown
24" drain line	Unknown
Orifice flow at elevation 1791.0	60
Principal spillway capacity at elevation 1795.5	139
Emergency spillway at elevation 1801.0	5500

c. Elevation (U.S.G.S. Datum) (feet). - Elevations worked from spillway orifice shown on as-built drawings.

Top of dam - low point	1801.4
Top of dam - design height	1801.0
Maximum pool - design surcharge	1798.4
Full flood control pool	1796.2
Normal pool	1787.0
Emergency spillway crest	1796.2
Principal spillway crest	1791.0
Spillway orifice invert	1787.0
Drain line entrance invert	1741.0
Exit invert on principal spillway pipe	1738.0
Streambed at centerline of dam	1738.0
Maximum tailwater	None
Toe of dam	1738.0

d. Reservoir (feet).

Length of maximum pool	4,400
Length of normal pool	3,400
Length of flood control pool	4,000

e. Storage (acre-feet).

Normal pool	1,075
Flood control pool	1,796
Top of dam	2,400

f. Reservoir Surface (acres).

Top of dam	123
Design maximum pool	103
Flood control pool	94
Normal pool	67
Emergency spillway crest	94

g. Dam.

Type	Earthfill
Length	1,030 feet
Height	63 feet
Top width	20 feet
Side slopes - upstream	3H:1V with berm
- downstream	2H:1V with berm
Zoning	Yes
Impervious core	Yes
Cutoff	Partial
Grout curtain	None

h. Reservoir Drain.

Type	24" concrete pipe connected to principal spillway
Length	335 feet
Closure	Slide gate operated from upstream slope
Access	Through principal spillway
Regulating Facilities	Slide gate on upstream toe

i. Emergency Spillway.

Type	Uncontrolled open cut
Length	150 feet
Crest Elevation	1796.2
Gates	None
Upstream channel	260 foot long open cut
Downstream channel	100 foot long open cut

SECTION 2 ENGINEERING DATA

2.1 Design. Design data was reviewed from the files of the Commonwealth of Pennsylvania, Department of Environmental Resources and the Soil Conservation Service. This data consisted of as-built drawings, design reports, permits, photographs of construction and laboratory testing. This data was reviewed for this study.

The hydrologic data consisted of:

- a. Design assumptions and criteria.
- b. Design storm inflow hydrograph.
- c. Design hydrograph computations.
- d. Freeboard hydrograph computations.
- e. Stage vs. storage computations.
- f. Stage vs. storage curves.
- g. Outlet conduit discharge curves.
- h. Drawdown time calculations.
- i. Duration of flow through emergency spillway calculations.
- j. Emergency spillway design.

In addition, the subsurface investigations and geology are summarized in a report format. Summaries of laboratory testing which consists of classifications, proctors, triaxials, permeabilities, consolidation tests were reviewed. A slope stability analysis was conducted for the dam. The Swedish Circle Failure Method was utilized. Two cases were checked. Strength parameters of $\phi = 28^\circ$, $C = 250$ psf were used throughout for Case 1. Factors of safety of 1.6 for the upstream and downstream slopes were obtained. For Case 2, strength parameters of $\phi = 16.5^\circ$, and $C = 500$ psf were used for the upper portions of the embankment and $\phi = 500$ psf $C = 350$ psf were used for the lower portion of the embankment. This case gives lower safety factors of 1.34 for the 3.1 upstream slope with full drawdown conditions and 1.29 for the downstream slope. The factor of safety for partial drawdown is 1.55. The designer's conclusions stated that the safety factors calculated for the design are sufficient because of the conservative strength parameters used in the analysis.

2.2 Construction. Construction inspection reports and photographs of construction were reviewed for this study.

2.3 Operation. Operating records are maintained by the Pennsylvania Fish Commission and the Soil Conservation Service. Operation and maintenance inspections are conducted on a yearly basis. Inspection reports are maintained in the Fish Commission and Soil Conservation Service Files.

2.4 Evaluation.

a. Availability. Engineering data was provided by PennDER, Bureau of Dams and Waterways Management; U.S. Department of Agriculture, Soil Conservation Service; and the Pennsylvania Fish Commission. Members of the Fish Commission and the Soil Conservation Service accompanied the inspection team to answer questions on design and operation of the dam.

b. Adequacy. The type and amount of design data and other engineering information is substantial. The information is sufficient to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Beechwood Lake Dam was conducted by personnel of L. Robert Kimball and Associates accompanied by Fish Commission and Soil Conservation Service staff on June 27, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in good condition. The dam appears to conform closely to the as-built drawings. From a brief survey conducted during the inspection, it was noted that the crest of the dam is approximately 0.4 feet higher than the design height of the dam. The upstream slope is 3H:1V and covered with riprap in the vicinity of normal pool and principal spillway crest. The downstream slope is 2H:1V. The upstream slope, downstream slope and crest are grass covered. No signs of erosion, seepage, or instability was noted during the inspection.

c. Appurtenant Structures. The reservoir level at the time of inspection was at elevation 1787.1. The emergency spillway crest is located at elevation 1796.2 which is approximately 0.7 feet higher than the design height. The emergency spillway was covered with grass and was in good condition. The principal spillway structure appeared to be in good condition. No deterioration of the concrete was noted. The drain line slide gate was operated during the inspection and appeared to be in good condition. The principal spillway impact basin is in good condition.

d. Reservoir Area. The watershed is covered mostly with farmland or woodland. The reservoir slopes are moderately steep and are not susceptible to massive landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel from Beechwood Lake Dam is narrow with a moderate grade. Several homes are located on the stream downstream from Beechwood Lake Dam. Approximately 1 mile downstream of Beechwood Lake is the village

of Sabinsville. Approximately 4 miles downstream is the town of Westfield. The total number of houses in the flood area is approximately 195.

3.2 Evaluation. The embankment and appurtenant structures appeared to be in good condition and well maintained. No wet areas, slides or slumps were noted on the embankment. The thick growth of grass may have obscured minor erosion areas.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the orifice invert (elevation 1787.0). During flooding, no operations are conducted. The principal spillway and emergency spillway are designed to act automatically. Three times each year the drain line slide gate is operated and lubricated.

4.2 Maintenance of the Dam. Maintenance of the dam is considered good. Most of the maintenance is contracted.

4.3 Maintenance of Operating Facilities. Maintenance of the operating facilities is considered good. The drain line slide gate is operated and lubricated three times each year.

4.4 Warning System in Effect. The Pennsylvania Fish Commission (PFC) indicated during the inspection that a warning system is being developed and that preliminary maps have been developed which outline the downstream area that would be affected in the event of a dam failure. The warning system should be formalized and made a part of the operation and maintenance manual.

SECTION. 5
HYDRAULIC AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. Hydraulic and hydrologic information are contained in the design report by the Soil Conservation Service, U.S. Department of Agriculture. Pertinent data is based on SCS criteria and is as follows:

Structure Classification	Class "C" Structure (high Hazard)
Drainage Area	3.3 square miles
Time of Concentration	3.47 hours
Emergency Spillway Hydrograph	6 hrs. Point Rainfall
	P (precipitation) = 10.88 inches
	AMC III (Antecedent Moisture Condition)
	CN (Curve Number) = 88

b. Experience Data. The maximum flood to date occurred during June, 1972. However, the maximum water level and discharge are unknown.

c. Visual Observations. The principal spillway and emergency spillway structures appear to be in good condition. Even though the emergency spillway crest is approximately 0.7 feet higher than the design height, the top of dam is approximately 0.4 feet higher than design.

d. Overtopping Potential. To determine the overtopping potential for the Beechwood Lake Dam, a review of design calculations was conducted. The design calculations consist of an inflow hydrograph, stage-discharge computations and stage-storage computations. Using a triangular unit hydrograph with 21.75 inches rainfall over the drainage area, the peak inflow was determined to be 6826 cfs. After routing the freeboard hydrograph through the reservoir, the peak discharge through the spillway was 5500 cfs. The Spillway Design Flood (SDF) for a high hazard-intermediate size dam is the PMF (Probable Maximum Flood).

e. Spillway Adequacy. The design calculations appear to be adequate to meet the Corps of Engineers guidelines. Design calculations indicate the dam is capable of safely handling the PMF. The spillway capacity is adequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No signs of sloughing, erosion or instability were noted during the inspection. The embankment appears to be in good condition.

b. Design and Construction Data. Stability analyses were conducted for the design of the dam (See Section 2.1 for more detailed information).

c. Operating Records. Records of water levels and discharges are not recorded. Safety inspections and operation and maintenance inspections are conducted on a yearly basis by the Pennsylvania Fish Commission and the Soil Conservation Service.

d. Post Construction Changes. There have been no post construction changes to the dam.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analysis has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. Because of the low risk of seismic occurrence and the visual observations, no static analysis is required.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in good condition. The visual observations, review of available information, hydrologic review and past operational performance indicate that Beechwood Lake Dam's spillway is adequate. The spillway is capable of controlling the PMF without overtopping. Adequate stability analyses have been conducted for the design of the structure.

b. Adequacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented.

d. Necessity for Further Investigation. No further investigations are required at this time.

7.2 Recommendations/Remedial Measures.

1. Continue annual safety inspections and operation and maintenance inspections.

2. The warning system should be formalized and made a part of the operation and maintenance manual.

APPENDIX A

CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Beechwood Lake Dam COUNTY Tioga STATE Pennsylvania ID# PA 37
TYPE OF DAM Earthfill HAZARD CATEGORY High
DATE(S) INSPECTION June 27, 1979 WEATHER Clear, Warm TEMPERATURE 80°
POOL ELEVATION AT TIME OF INSPECTION 1787.1 M.S.L. TAILWATER AT TIME OF INSPECTION 1738.4 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, L. Robert Kimball and Associates
James T. Hockensmith, L. Robert Kimball and Associates
Kuang-hwei Chuang, L. Robert Kimball and Associates
Don Lindsey, Soil Conservation Service
Dennis Carman, Soil Conservation Service
Danny O'Neil, Jon Grindall, both of the Pennsylvania Fish Commission
James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None. Partially obscured by high grass.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Vertical alignment - good.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	High grass on both upstream and downstream slopes and crest of dam.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good.	
ANY NOTICEABLE SEEPAGE	No seepage noted.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	Seepage drain outlets into impact basin. Right drain had less than 1 gallon/minute drainage during the inspection.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	
STAFF GAUGE OR RECORDER	N/A	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit not observed except at discharge end.	
INTAKE STRUCTURE	Intake structure appears to be in good condition.	
OUTLET STRUCTURE	Impact basin in good condition.	
OUTLET CHANNEL	Outlet channel in good condition.	
EMERGENCY GATE	Operable during the inspection.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None. Grassed control section.	
APPROACH CHANNEL	Open cut, grassed.	
DISCHARGE CHANNEL	Open cut, grassed.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

DOWNSTREAM CHANNEL

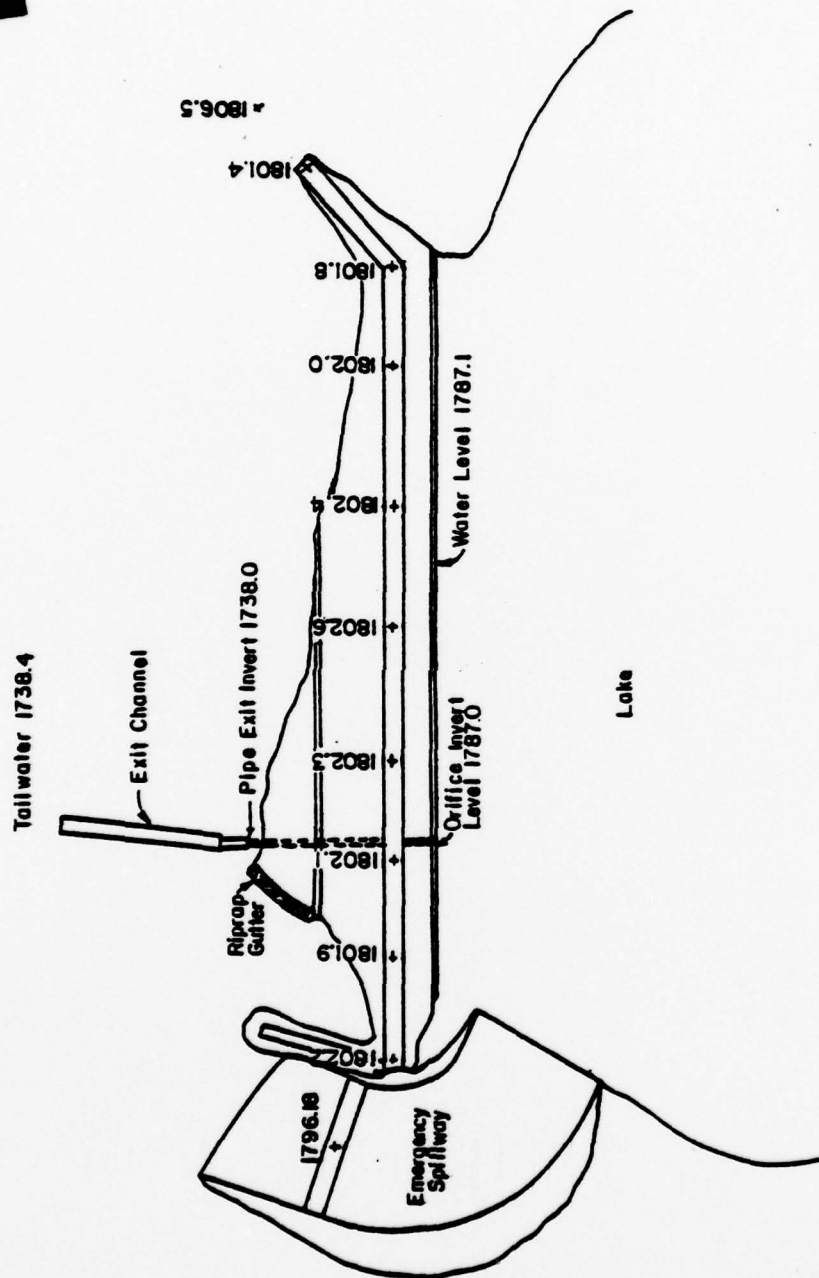
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow, moderate grade.	
SLOPES	Stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Within four miles downstream of the dam, approximately 195 homes (800 people).	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately steep, stable.	
SEDIMENTATION	Does not appear to be excessive.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



BEECHWOOD LAKE DAM
Scale: 1" = 200'

APPENDIX B

CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Beechwood Lake Dam

ID# PA 37

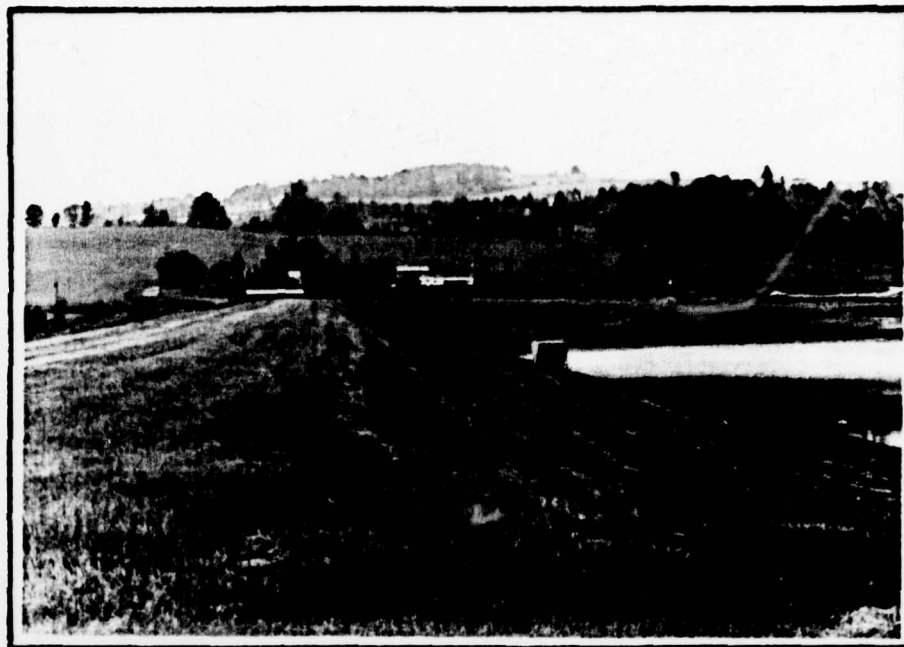
ITEM	REMARKS
AS-BUILT DRAWINGS	Yes, from Soil Conservation Service.
REGIONAL VICINITY MAP	U.S.G.S quadrangle and construction drawings.
CONSTRUCTION HISTORY	Inspection reports in Pennder and SCS files.
TYPICAL SECTIONS OF DAM	As-built drawings.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	Construction drawings. Construction drawings. Hydrologic report. Hydrologic report. None.

ITEM	REMARKS
DESIGN REPORTS	SCS files.
GEOLOGY REPORTS	SCS files.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	SCS files.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	SCS files.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Construction drawings.

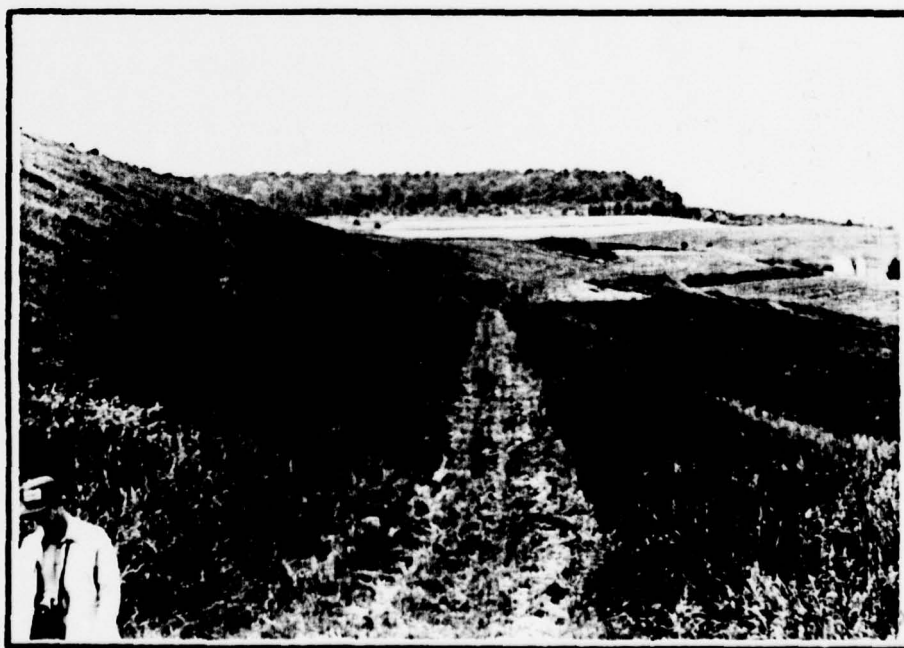
ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	SCS files.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Construction drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Construction drawings.

APPENDIX C
PHOTOGRAPHS



Overview of crest of dam and upstream slope.



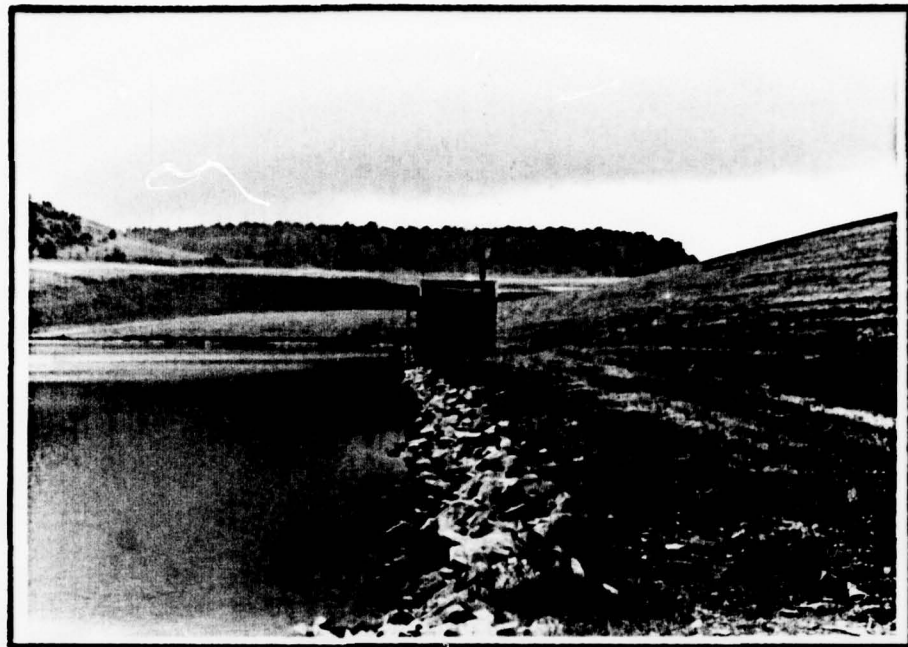
Downstream slope of dam.



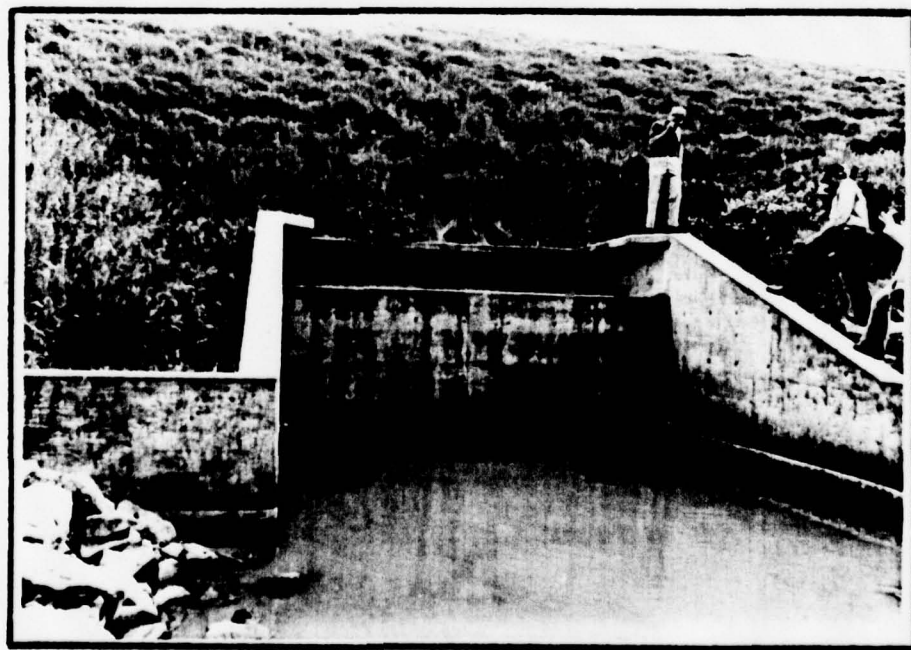
Spillway approach channel.



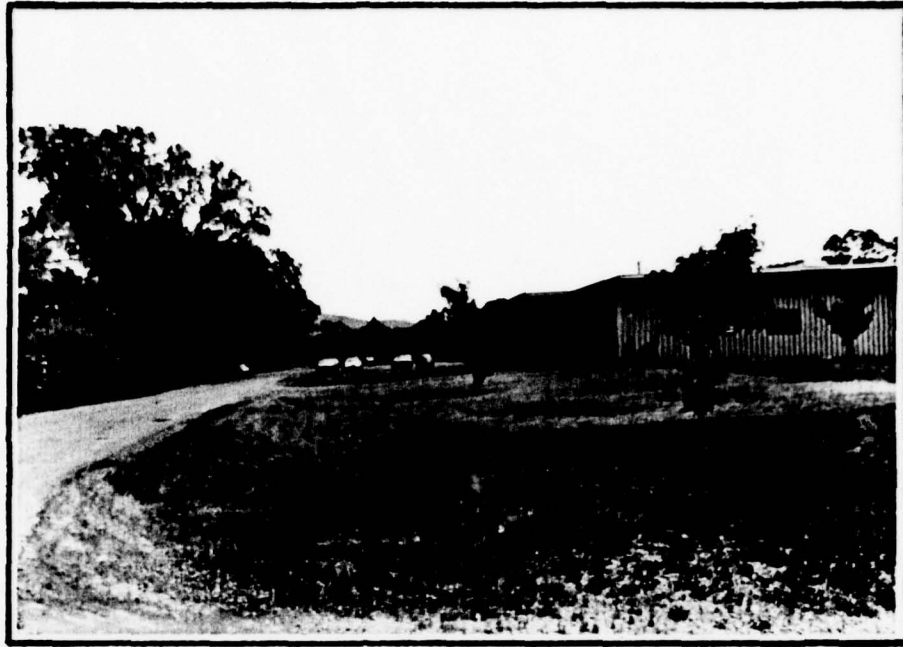
Spillway discharge channel.



Principal spillway, orifice invert and
drain line structure.



Impact basin at toe of dam.



Clothing factory downstream of dam.



Business downstream of dam.

APPENDIX D
HYDROLOGY AND HYDRAULICS

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.3 square miles, farmland and woodland

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1787.0 (1075 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1796.2 (1796 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 1798.4

ELEVATION TOP DAM: 1801.4

SPILLWAY CREST:

- a. Elevation 1796.2
- b. Type Uncontrolled open cut
- c. Width 20 feet
- d. Length 150 feet
- e. Location Spillover Left abutment
- f. Number and Type of Gates None.

OUTLET WORKS: - Principal spillway

- a. Type Control structure with 30" concrete pipe
- b. Location Through dam
- c. Entrance inverts 1791.0
- d. Exit inverts 1738.0
- e. Emergency draindown facilities 24" pipe operated from slide gate near principal spillway

HYDROMETEOROLOGICAL GAUGES:

- a. Type None.
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: June 1972. elevation and discharge unknown

DESIGN REPORT

Elev. Storage Element of Factor Surface Runoff Peak In- 100 Year
 Max. Ac.-Ft. Structure **MILL CREEK WATERSHED**
 Stage Detection **WATERSHED PROTECTION PROJECT PA-454**
 by **MOORE TIOGA COUNTY, PENNSYLVANIA**
 Stage

The site of this proposed floodwater retarding dam is located on properties owned by Harold Hurd, Ira Baker and Roy Ackley. The earth dam will be on the property of Roy Ackley.

and wild-

The geographic location may be found on the Gaines, PA-NY quadrangle published by U. S. Geological Survey. Sheet 4 of this report is a transparent overlay of a portion of this quadrangle and may be used in locating the structure. Crest of Minimum - - - - -
 emergency storage

The purposes of the dam is to reduce flooding by providing temporary storage which is released through controlled outlets. This dam which has a watershed area of 2,112 acres has been classified as a class (c) structure according to criteria established in Washington Engineering Memorandum SCS-27.

1798.4 925 Design 1x6 hour - 10.01 5550 2177

The principal spillway consists of a 30-inch reinforced concrete water pipe and a 2-1/2' x 7-1/2' reinforced concrete riser. An earth emergency spillway and an embankment and foundation drainage has been provided.

condition III

The elevation of the combined sediment and fish and wildlife pool has been set at elevation 1787.0. This is also the elevation of a 2'-6" x 2'-9" orifice: point rain-fall

The crest of the riser is set at elevation 1791.0 to provide protection from low frequency flows when the only outlet is the orifice.

The emergency spillway is set at elevation 1795.0 which is the elevation required to provide temporary storage for 3.56 inches of runoff from the entire watershed. This storage does not include the discharge through the orifice and principal spillway. This required storage was determined by following the procedure in technical release 10 and using the rainfall obtained from TP 29 for a 100 year storm.

The peak discharge through the emergency spillway for the design storm is 2177 cfs with a velocity at the control section of 7.6 ft/sec. The flood routing procedure used to determine design high water and the top of the dam is described in Engineering Handbook, Section 5, Hydraulics, USDA, Soil Conservation Service.

The geology report and the Soils Laboratory report were used in determining the adequacy of the design.

REFERENCE

D-2

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 ENGINEERING & WATERSHED PLANNING UNIT
 UPPER DARBY, PENNSYLVANIA

DRAWING NO.

PA-454-R

SHEET 1 OF 4

DATE 3/15/61

DESIGN REPORT

Elev. Max. Stage	Storage Ac.-Ft.	Element of Structure Determined by Maximum Stage	Factor Which De- termines Stage	Surface Area Acres	Runoff Inches	Peak In- flow CFS	Peak Out- flow CFS
1187.0 1787	1075	Crest of orifice	Sediment and fish and wild- life storage	67	-	-	-
1795.0	721	Crest of emergency spillway	Minimum storage required for 100 year runoff	-	-	-	139
1798.4	925	Design high water	1x6 hour point rainfall moisture condition III	-	10.01	3550	2175
1801.0	1220	Set top of dam	2-1/2x6 hour point rain- fall moisture condition II	-	15.6	6826	5500

The peak discharge through the principal spillway immediately prior to flow starting in the emergency spillway is 139 cfs. The time to empty the reservoir between the crest of the emergency spillway and the crest of the orifice is 6.8 days.

The peak discharge through the emergency spillway for the design storm is 2175 cfs with a maximum velocity at the control section of 7.8 feet per second. The duration of flow in the emergency spillway is 11.5 hours.

The geology report and the Soils Laboratory report were used in determining the adequacy of the design.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING & WATERSHED PLANNING UNIT
UPPER DARBY, PENNSYLVANIA

DRAWING NO.

PA-454-R
SHEET 2 OF 4
DATE 5/15/61

1

DESIGN ASSUMPTIONS AND CRITERIA

MILL CREEK WATERSHED

TIOGA COUNTY, PENNSYLVANIA

SITE PA-454

1. Class (c) structure.
2. Fish and wildlife pool set at surface area of 70 acres or volume of 7
1,150 acre feet. 1
3. From stage storage curve and information from step 2, determine elevation of permanent pool.
4. Set elevation of crest of orifice 1' below elevation of permanent pool to offset base flow into the permanent pool.
(Note: Base flow of 15 c.f.s. requires a head of 1.3' to release it through orifice.)
5. ~~Determine elevation of crest of weir of the principal spillway by storing 2.55 inches of runoff between the elevation of the permanent pool and the elevation of the crest of the weir as set forth by the work plan party.~~
Determine elev. of crest of E.S. by storing 3.56" between permanent pool & crest of the E.S.
6. ~~Determine elevation of crest of emergency spillway by storing 1.12 inches of runoff between the elevation of the crest of the weir and the elevation of the crest of the emergency spillway as set forth by the work plan party.~~
7. Determine elevation of design high water by routing runoff for 1.25 x 6-hour rainfall, moisture Condition III, as per Hydrology Guide (Section 4 of Engineering Handbook) Supplement A, Figure 3.21-1.
(Note: Routing is started at the five-day drawdown point.)
8. Determine elevation of top of dam by routing runoff for 2.5 x 6-hour rainfall as per previous assumption. Use either this elevation or 2 plus the maximum design high water elevation, whichever is greater.
9. Determine critical slope of exit channel of emergency spillway at 25% maximum design discharge.
10. Check velocity of emergency spillway discharge at 50% of maximum design flow.
11. Check Pennsylvania Department of Forests and Waters' "red-line" curve against structure for overtopping.
12. Determine top width of fill by formula: $\frac{H + 35}{5}$.
13. Side slopes of earth embankment: 3:1 upstream; 2:1 downstream.
14. Side slopes of emergency spillway: 3:1.

DESIGN SUMMARY
MILL CREEK WATERSHED
TIOGA COUNTY, PENNSYLVANIA
SITE PA-454

1. Elevation of top of settled fill	1,801.0'
2. Elevation of design maximum flow	1,798.4'
3. Elevation of crest of emergency spillway	1,795.5'
4. Elevation of crest of principal spillway	1,793.5' 1793.0
5. Elevation of crest of first stage orifice	1,787.0'
6. Elevation of permanent pool	1,788.0'
7. Elevation of lowest point along centerline of fill	1,739.3'
8. Elevation of invert of pipe conduit inlet	1,740.0'
9. Elevation of centerline of pipe conduit outlet	1,739.5'
10. Elevation of invert of pipe conduit outlet	1,738.0'
11. Bottom width of emergency spillway	150'
12. Side slopes of emergency spillway	3:1
13. Inside dimensions of riser	2 1/2' x 7 1/2' by 8'
14. Inside diameter of pipe conduit	36" 30"
15. Length of pipe conduit	204' 192'
16. Top width of fill	20'
17. Height of fill	61'
18. Side slopes of earth fill	Upstream 3:1 Downstream 2:1
19. Volume of earth fill	122,453 cu.yds.
20. Drainage area	3.3 sq.mi.
21. Volume of permanent pool	1,150 ac.ft.
22. Volume of flood detention pool	1,749 ac.ft.
23. Structure classification	"c"
24. Height of riser	55.5' 53.0'

A-73
-7-58

**DESIGN STORM INFLOW HYDROGRAPH
WORK SHEET**

Watershed: MILL CREEK State: Pa County: _____ Reservoir No.: PA 454

Drainage Area (A) 2110 Acres = 3.3 Sq. Mi.

Hazard _____ Hazard Coefficient C

Weighted Curve Number (See Section 3.21 "Design Hydrograph," P. 12)				
(1) Soil Group	(2) Complex (Land Use)	(3) Complex No. Table 3.9-1, 2	(4) Acres (A)	(5) (3) x (4)
A	CROPLAND	73	200	14600
B	SMALL GRAIN	70	110	7700
C	GRASSLAND	72	1100	79200
B	WOODLAND	60	300	18000
C	WOODLAND	65	400	26000

Weighted Curve II $\frac{(5)}{(4)} = \underline{69}$ Sum

2110 145500

Weighted Curve I Conversion
III Table 3.10-1 86

Time of Concentration - T_c					
(1) Description of Course of Runoff Water	(2) Slope of Course (%)	(3) Length (1) of Course (ft.)	(4) Velocity of Runoff Water (v) (ft/sec)	(5) Time (sec)	(6) Time T_c (hr)
OVERLAND WOODS	5%	2200	0.7	3140	
NAT. DRAW	3%	2000	0.8	2500	
WATER COURSE		11200	2.0	5600	
STREAM		3000	2.4	1260	
Sum				<u>12500</u>	<u>3.47</u>

For channel flow - use Manning's formula.
For overland flow:

Cover	Slope in %						
	0-3	4-7	8-11	12-15	16-20	21-25	26-30
Woodland	0.5	1.0	1.5	1.7	2.0	2.7	3.5
Pasture	0.8	1.5	2.2	2.6	3.0	4.1	4.5
Cultivated (Row Crop)	1.0	2.0	3.0	3.5	4.0	4.5	5.0
Pavement	5.0	12.0	15.5	18.0	-	-	-
Natural Draw Not Well Defined	0.8	2.5	4.0	6.0	-	-	-

PA-83
1/13/59

DESIGN HYDROGRAPH COMPUTATION FORM

Watershed MILL CREEK State PA.

Structure Site or Sub-area PK 454

Storm Distribution Curve B Hydrograph Family # 1

D.A. 3.3 sq.mi. Pt. Rainfall 10.88 inches Aerial Rainfall 10.01 inches

R.O. Condition III R.O. Curve No. 24 Storm Duration or Freq. 6 HR

$T_c = 3.47$ hrs. $Q = 8.2$ inches $T_p = 0.686$ $T_c = 2.38$ $T_o = 5.47$ hr.

$\frac{T_o}{T_p}$ Computed = 2.30 $\frac{T_o}{T_p}$ used: 2.00 Revised $T_p = 2.73$ hr.

$Q_p = \frac{484 A}{\text{Rev. } T_p} = 585$ c.f.s. $q_p \times Q = 4797$ c.f.s.

T (Column) = $\frac{T}{T_p} \times \text{Rev. } T_p$ q (Column) = $\frac{q_c}{q_p} (q_p Q)$

Check: $\frac{q}{q_p} = \frac{(T/t) (\leq q)}{645 A}$

Table 3.21-7 (Sheet 21 of 52)

Line No.	$\frac{t}{T_p}$	$\frac{q_c}{q_p}$	T hours	8 c.f.s.	Line No.	$\frac{t}{T_p}$	$\frac{q_c}{q_p}$	T hours	8 c.f.s.
1	0.00	0.000	0	0	21	5.80	0.004	15.83	19
2	0.29	0.007	0.79	34	22	6.09	0.002	16.63	10
3	0.58	0.035	1.58	168	23	6.38	0.001	17.42	5
4	0.87	0.164	2.38	787	24	6.67	0.000	18.21	0
5	1.16	0.432	3.17	2072	25				
6	1.45	0.669	3.96	3209	26				
7	1.74	0.740	4.75	3550	27			Check	
8	2.03	0.480	5.54	3262	28				
9	2.32	0.561	6.33	2691	29		$Q_c = 0.29(2.73)$	22.698	
10	2.61	0.441	7.13	2115	30		645 (3.3)		= 8.33
11	2.90	0.319	7.92	1530	31				✓
12	3.19	0.212	8.71	1017	32				
13	3.48	0.140	9.50	672	33				
14	3.77	0.094	10.29	451	34				
15	4.06	0.063	11.06	302	35				
16	4.35	0.042	11.85	201	36				
17	4.64	0.028	12.67	134	37				
18	4.93	0.017	13.46	82	38				
19	5.22	0.011	14.25	53	39				
20	5.51	0.007	15.04	34	40				

PA-83
1/13/59

15

FREE BOARD HYDROGRAPH COMPUTATION FORM

Watershed MILL CREEK State PA.

Structure Site or Sub-area PA 454

Storm Distribution Curve B Hydrograph Family # 2

D.A. 3.3 sq.mi. Pt. Rainfall 21.75 inches Aerial Rainfall 20.01 inches

R.O. Condition II R.O. Curve No. 69 Storm Duration or Freq. 6 HR.

$T_c = 3.47$ hrs. $Q = 156$ inches $T_p = 0.686$ $T_c = 2.38$ $T_o = 5.21$ hr.

$\frac{T_o}{T_p}$ Computed = 2.19 $\frac{T_o}{T_p}$ used: 2.00 Revised $T_p = 2.61$ hr.

$Q_p = \frac{484 A}{\text{Rev. } T_p} = 612$ c.f.s. $q_p \times Q = 9547$ c.f.s.

T (Column) $\frac{+}{T_p} \times \text{Rev. } T_p$ q (Column) = $\frac{q_c}{q_p} (q_p Q)$

Check: $Q = \left(\frac{1}{t} \right) \left(\frac{1}{q} \right)$
645 A

Table 3.21-7 (Sheet 27 of 52)

Line No.	$\frac{t}{T_p}$	$\frac{q_c}{q_p}$	T hours	8 c.f.s.	Line No.	$\frac{t}{T_p}$	$\frac{q_c}{q_p}$	T hours	8 c.f.s.
1	0.00	0.000	0	0	21	5.20	0.004	14.62	38
2	0.28	0.004	0.73	38	22	5.88	0.003	15.35	29
3	0.56	0.040	1.96	382	23	6.16	0.002	16.08	19
4	0.84	0.170	2.19	1123	24	6.44	0.001	16.81	10
5	1.12	0.428	2.92	4086	25	6.72	0.000	17.54	0
6	1.40	0.695	3.65	6158	26				
7	1.68	0.715	4.38	6826	27				
8	1.96	0.677	5.12	6463	28				
9	2.24	0.574	5.85	5480	29			Check	
10	2.52	0.472	6.58	4506	30			$Q = (0.28) 46,150 (2.61)$	
11	2.80	0.349	7.31	3523	31			$645(3.3)$	$= 15.8$
12	3.08	0.247	8.04	2358	32				✓
13	3.36	0.168	8.77	1409	33				
14	3.64	0.113	9.50	1079	34				
15	3.92	0.075	10.23	716	35				
16	4.20	0.050	10.96	477	36				
17	4.48	0.034	11.69	325	37				
18	4.76	0.021	12.42	200	38				
19	5.04	0.014	13.15	134	39				
20	5.32	0.008	13.89	76	40				

MILL CREEK - W.S

PA 454

11/12/50

TH

STAGE vs STORAGE COMPUTATIONS

(EXCAVATION HAS NOT BEEN ADDED TO VOLUMES)

[illegible]

Flow Constants

Orifice

$$Q_o = CA\sqrt{2gh}$$

$$Q_o = 36.7 H_o^{\frac{1}{2}}$$

$$C = 0.665$$

$$A = 2.5 \times 2.75 = 6.88 \text{ sq'}$$

$$H_o = WS - 1788.38'$$

Weir

$$Q_w = CLH^{\frac{3}{2}}$$

$$Q = 51 H^{\frac{3}{2}}$$

$$C = 3.4$$

$$L = 15'$$

Conduit

$$Q_p = \frac{A\sqrt{2gh}}{\sqrt{1 + K_r + K_p L + K_d}}$$

$$Q_p = 0.471 \times 4.9 \times 8.02 \sqrt{h}$$

$$Q_p = 18.5 H^{\frac{1}{2}}$$

$$\text{Riser } 2\frac{1}{2}' \times 7\frac{1}{2}'$$

$$A_r = 18.75 \text{ sq'}$$

$$L_r = 50'$$

$$30" \text{ Dia pipe} = 4.9 \text{ sq'}$$

$$K_r = 1.5$$

$$K_p = 0.00922$$

$$K_d = 1.0$$

$$\frac{1}{\sqrt{1.0 + 1.5 + (200 \times 0.00922)}} = \frac{1}{\sqrt{4.3}}$$

$$= \frac{1}{2.1} = 0.471$$

PA 959

D-11

SITE PA 454

MILL CREEK WATERSHED

THI

4/5/61

DURATION OF FLOW THROUGH EMERGENCY SPILLWAY

FROM DESIGN STORM ROUTING:

T_0 , TIME AT WHICH EM S/W BEGINS TO FLOW	=	4.3 HR
T_1 , TIME AT WHICH EM S/W FLOW IS MAX.	=	7.0 HR
S_0 , STORAGE AT T_0	=	395 AC FT
S_{MAX} , STORAGE AT T_1	=	748 AC FT
Q_{MAX} , MAX OUTFLOW RATE (AT T_1)	=	1968 CFS
I_{MAX} , TOTAL INFLOW VOLUME	=	1443 AC FT
I , INFLOW VOLUME AT TIME T_1	=	1078 AC FT

DURATION OF FLOW IN EM, S/P = $T_2 + T_3$ WHERE $T_2 = T_1 - T_0$

$$\text{AND } T_3 = \frac{(I_{MAX} + S_{MAX}) - (I + S_0)}{Q_{MAX}} \times 24.2$$

$$T_2 = 7.0 - 4.3 = 2.7 \text{ HR}$$

$$T_3 = \frac{(1443 + 748) - (1078 + 395)}{1968} \times 24.2$$

$$= 8.8 \text{ HRS}$$

$$\text{DURATION OF FLOW} = 2.7 + 8.8 = \underline{\underline{11.5 \text{ HRS}}}$$

SITE PA 454

MILL CREEK WATERSHED

THI /
12/17/60

CRITICAL SLOPE OF EXIT CHANNEL OF EM S/P

25% MAX. DESIGN DISCHARGE = 543.75 CFS
BOTTOM WIDTH OF EM S/P = 150 FT.

$$q_c = \frac{543.75}{150} = 3.63 \text{ CFS/FT}$$

SC FROM ES 98 SHEET 3 OF 4 = 2.59 %

USE 2.6 %

VELOCITY OF EM S/P DISCHARGE

50% MAX DESIGN DISCHARGE = 1087.5 CFS
BOTTOM WIDTH OF EM S/P = 150 FT

$$q_c = \frac{1087.5}{150} = 7.25 \text{ CFS/FT}$$

Vc FROM ES 98 SHEET 1 OF 4 = 6.2 FPS

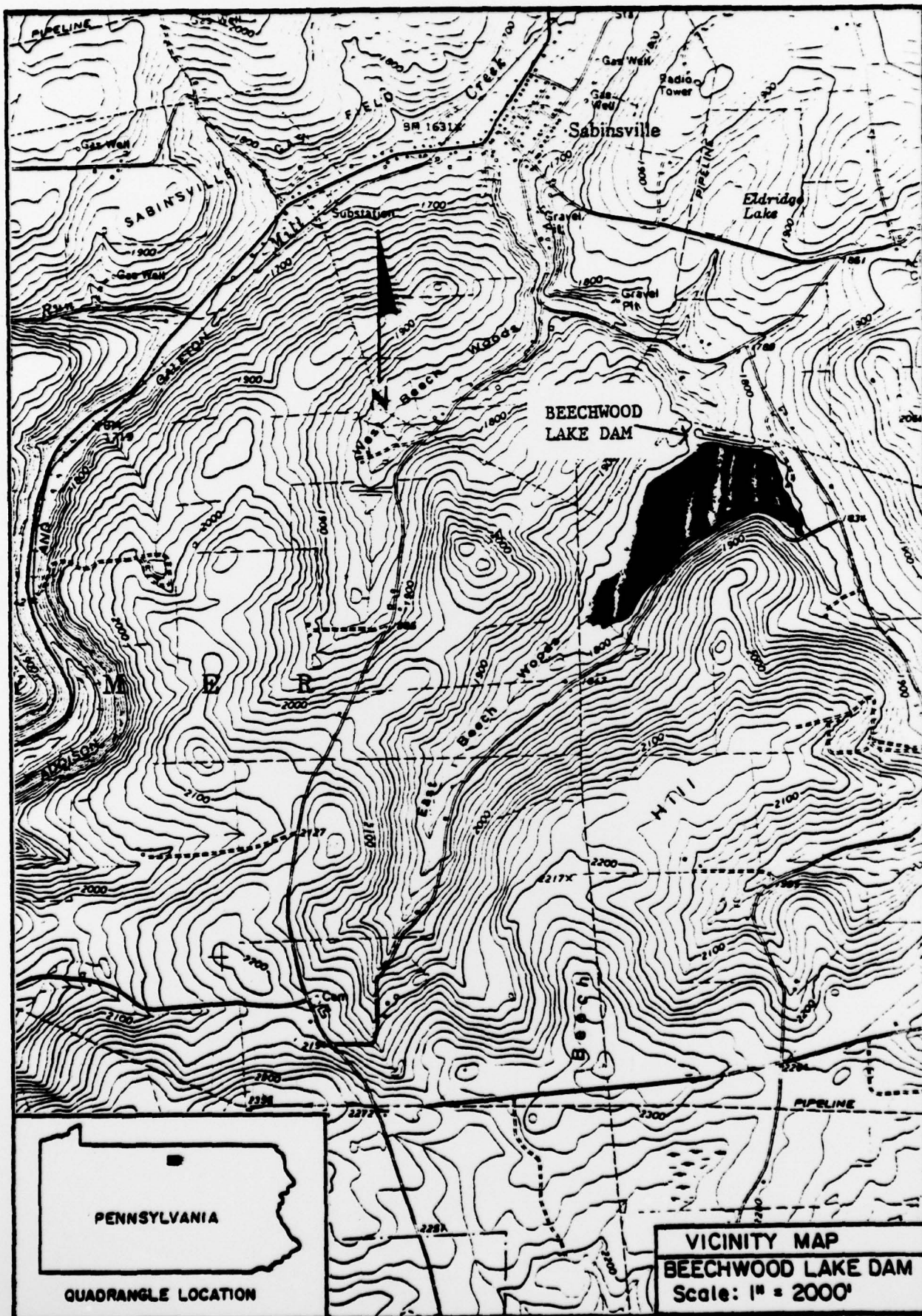
CHECK OF PA DEPT OF FORESTS AND WATERS
"RED LINE CURVE" FOR OVERTOPPING

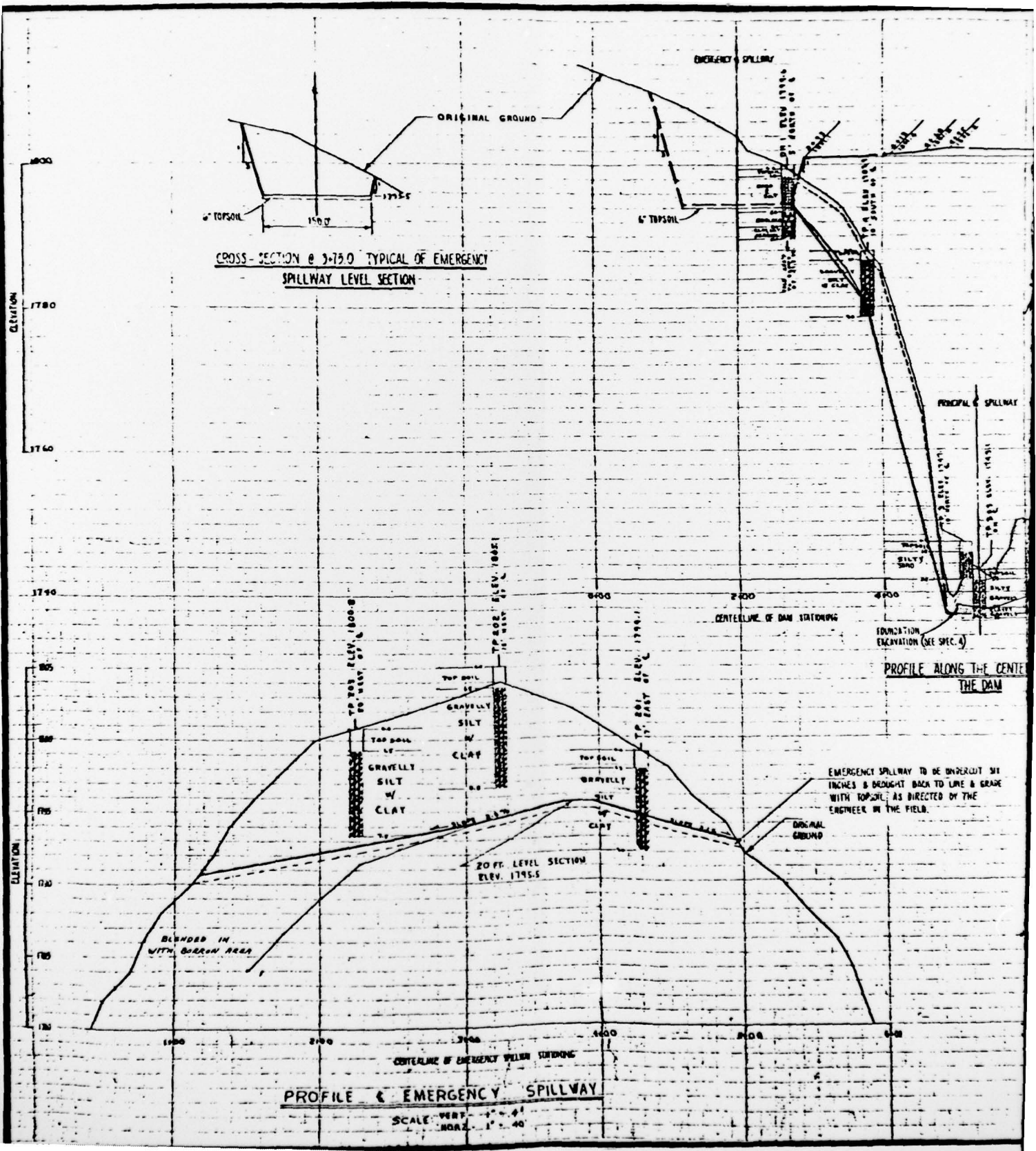
FROM CURVE $860 \times 3.3 = 2838$ CFS MUST BE PASSED
WITHOUT OVERTOPPING

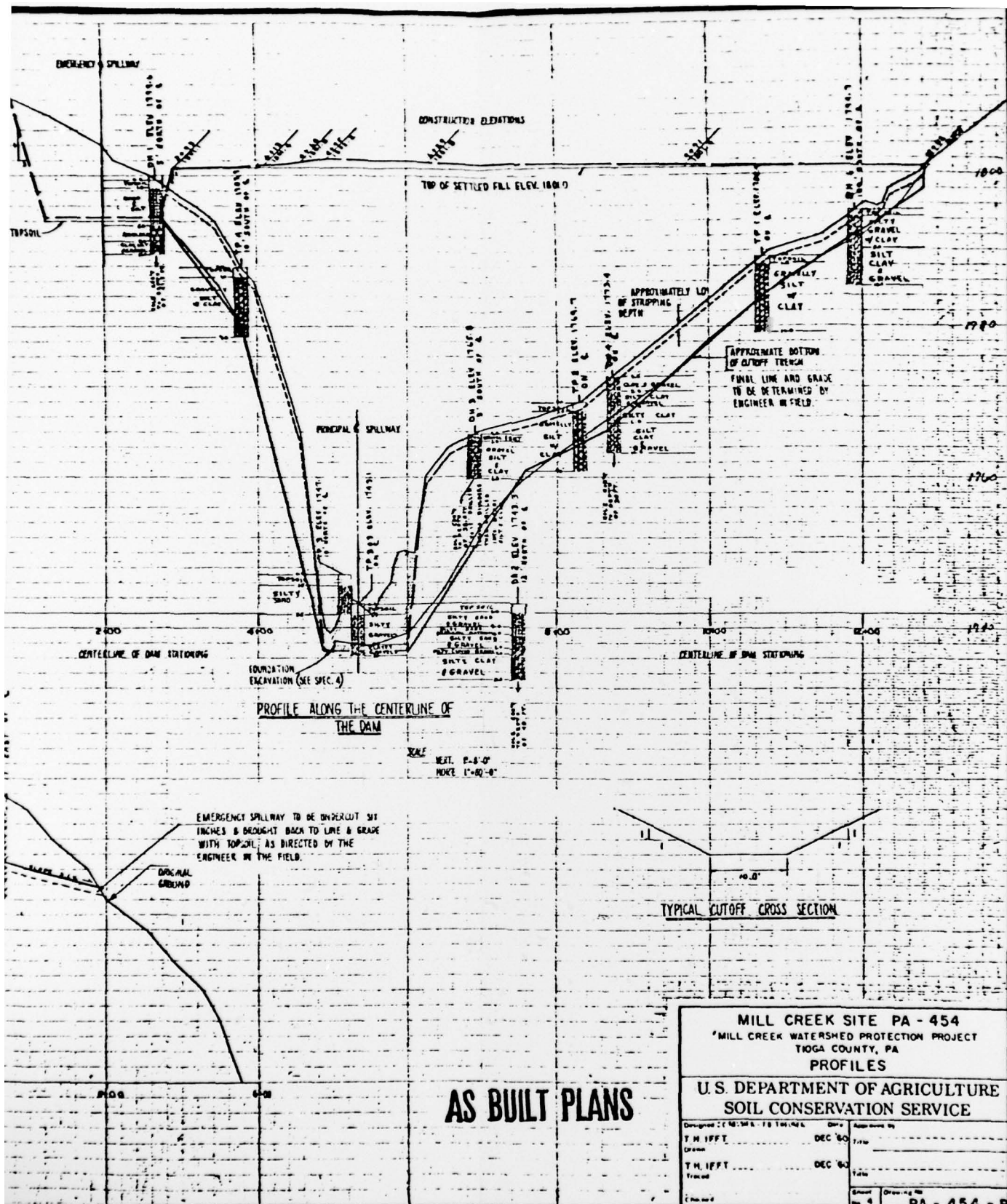
FROM FREEBOARD HYDROGRAPH MAX DISCHARGE
EQUALS 3560 CFS THEREFORE OVERTOPPING
WILL NOT OCCUR

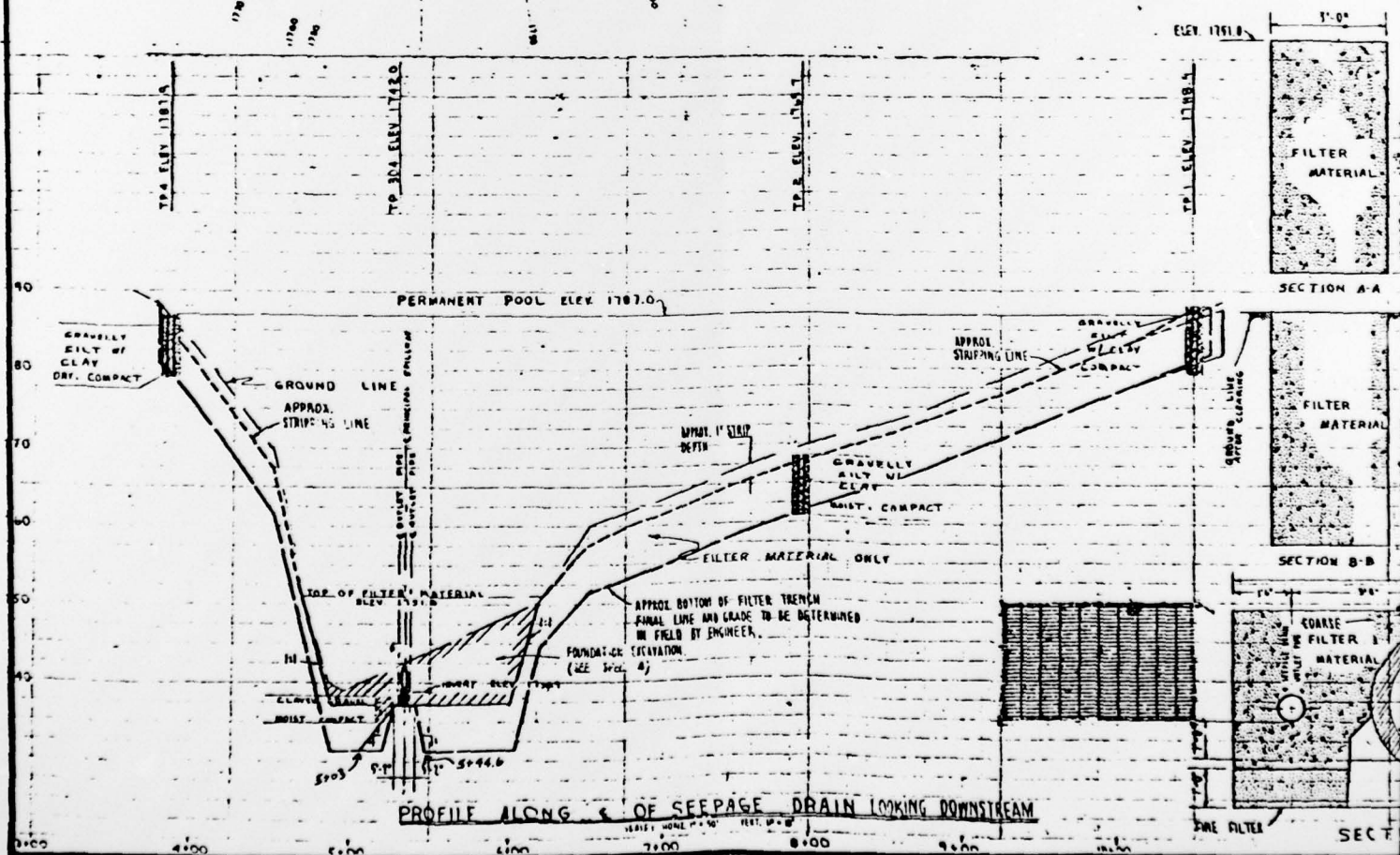
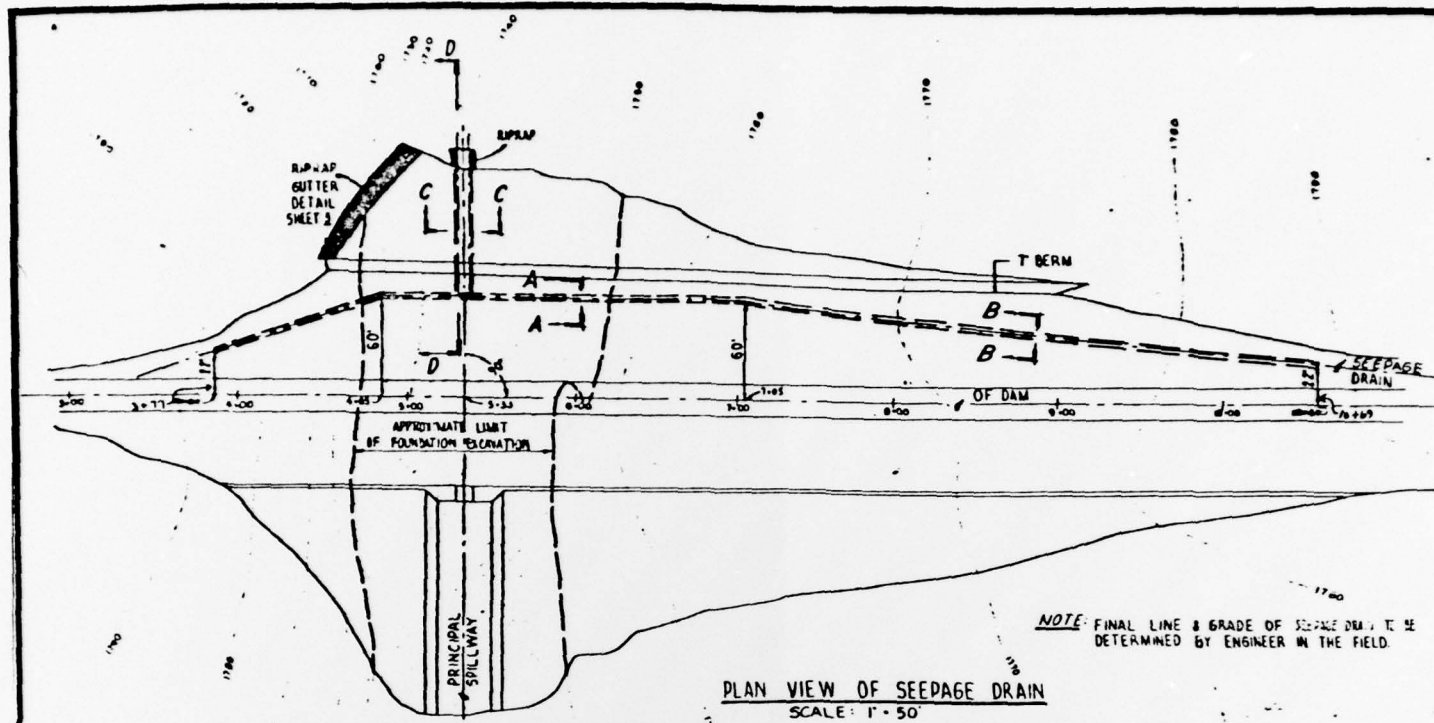
APPENDIX E

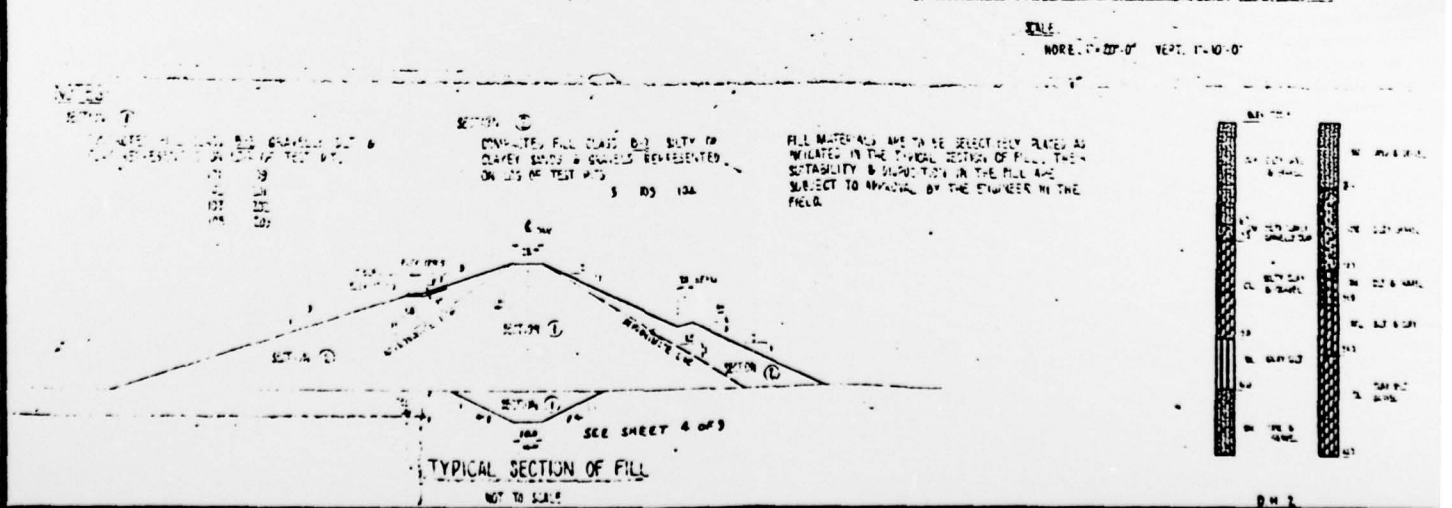
DRAWINGS











APPENDIX F

GEOLOGY

General Geology.

Beechwood Lake Dam lies within the Allegheny Mountain Section of the Appalachian Plateaus Physiographic Province as described by Fennemann (1938). The area is structurally typified by broad, gentle folding. Glaciation has rounded the ridges and filled major valleys with thick deposits of sand and gravel.

Beechwood Lake Dam is underlain by Upper Devonian aged marine sediments. These sediments are gray to olive brown shales, graywackes, and sandstones. They extend for a thickness of 2000 to 3000 feet. These marine sediments are made up of the Chemung and Portage beds which include the Burket, Brallier, Harrell, and Trimmers Rock. The Tully Limestone lies at the base of the marine beds.



GEOLOGIC MAP OF BEECHWOOD LAKE DAM AREA

Dm Marine beds
 Gray to olive brown shales, graywackes,
 and mudstones, contains "Chemung" beds
 and "Portage" beds including Hurket,
 Bralder, Harrell, and Trimmers Rock,
 Tully Limestone at base.

Scale: 1:250,000